

Infection Control: That Thing You Do

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Disclosures:
 Consultant, Hu-Friedy Manufacturing, Inc.
 Consultant, Coltene/SciCan, Inc

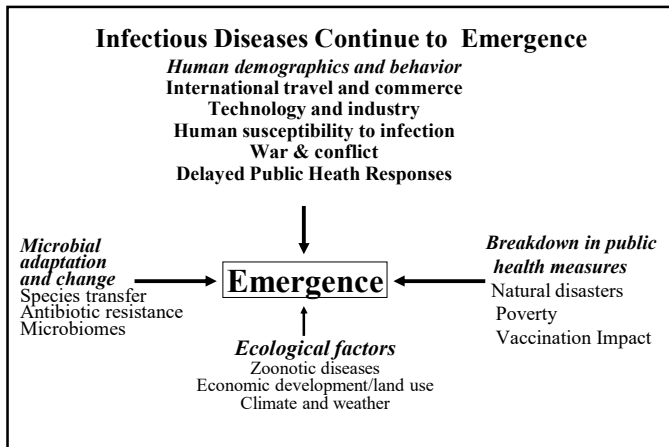
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How Perceptions & Reality Have Changed

Advances during early to mid-20th Century, led to increased optimism and “learned” statements:

- 1962: “..... the virtual elimination of infectious disease”
 Sir MacFarland Burnet (Nobel Lauriate)
- 1967: “.... time to close the book on infectious diseases, declare the war on pestilence won, and shift national resources to such chronic problems as cancer & heart disease.”
 Dr. William Stuart (US Surgeon General)

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Recent Threats: Unfortunately “The Beat Goes On”

- Pandemic Influenza – 2009 H1N1
- Norovirus
- Pertussis
- SARS
- Ebola
- Hepatitis A & C
- West Nile Virus
- Measles
- Community-acquired MRSA
- Zika
- Waterborne disease outbreaks -- Legionella, NTM, Pseudomonas

“Superbugs” Death Tolls Rises:

- ✓ infect 2,800,000 people annually; 1 case every 11 seconds; 1 death every 15 minutes; >35,000 deaths
- ✓ multi-drug resistant *Escherichia coli* and *Candida auris*
- ✓ antibiotic-resistant *N. gonorrhoeae*
- ✓ epidemic *Clostridium difficile*

CDC/JAM (2020)

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CDC/JAM (2020)

2019 NOVEL CORONAVIRUS

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Current Status of CDC Dental Infection Control Guidelines

- No evidence to support changes to 2003 guidelines
 - Principles of infection prevention have not changed
 - COMPLIANCE issues, not the ineffectiveness of current recommendations
- Summary of basic infection prevention expectations for safe care in all dental settings
 - Based on Standard Precautions
 - Supplements existing CDC recommendations (not a replacement)
 - Provides links to references & additional resources + checklists

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Current Status of CDC Dental Infection Control Guidelines

- Principles of infection prevention have not changed
- Appropriate use of Standard Precautions:
 - hand hygiene
 - PPE
 - cleaning & sterilization of insts and devices
 - cleaning & disinfection of environmental surfaces
 - sharps safety (engineering & work practice controls)
 - respiratory hygiene & cough etiquette
 - safe injection practices
- COMPLIANCE is the key!

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2016 CDC Dental Infection Control Guidelines

Key Recommendations for DENTAL UNIT WATER QUALITY in Dental Settings

- Use water that meets EPA regulatory standards for drinking water (i.e., $\le 500\text{ CFU/ml}$ of heterotrophic water bacterial) for routine dental treatment output water.
- Consult with the dental unit manufacturer for appropriate methods and equipment to maintain the quality of dental water.
- Follow recommendations for monitoring water quality provided by the manufacturer of the unit or waterline treatment product.
- Use sterile saline or sterile water as a coolant/irrigant when performing surgical procedures.

II.8 Dental Unit Water Quality

Elements To Be Assessed	Assessment	Notes/Areas For Improvement
A. Dental unit waterline treatment products/devices are used to ensure water meets EPA regulatory standards for drinking water (i.e., $\le 500\text{ CFU/ml}$ of heterotrophic water bacterial) for routine dental treatment output water.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
B. Product manufacturer instructions (i.e., waterline treatment product, dental unit manufacturer) are followed for monitoring the water quality.	<input type="checkbox"/> Yes <input type="checkbox"/> No	
C. Sterile saline or sterile water is used as a coolant/irrigant when performing surgical procedures.	<input type="checkbox"/> Yes <input type="checkbox"/> No	

Notes: Use devices specifically designed for delivering sterile irrigating fluids (e.g., sterile bulb syringe, single-use disposable products, and sterilizable tubing).

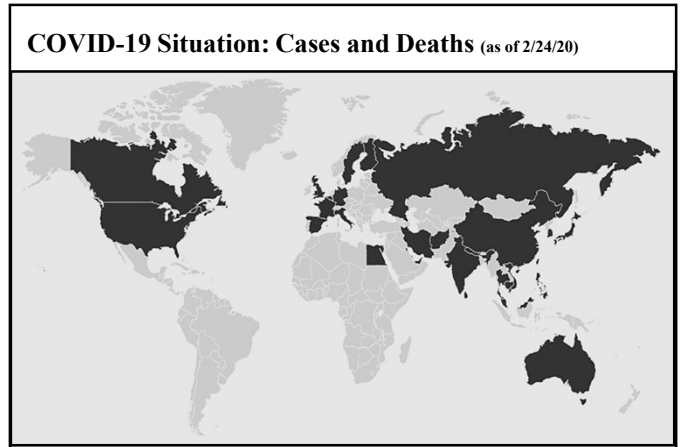
Notes: Examples of surgical procedures include biopsy, periodontal surgery, apical surgery, implant surgery, and surgical extractions of teeth.

checklist example

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Infectious Disease Update Coronavirus (COVID-19)

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COVID-19: Confirmed Cases in the United States*†	
Travel-related	12
Person-to-person spread	2
Total confirmed cases	14
Total tested	426

* This table represents cases detected and tested in the United States through U.S. public health surveillance systems since January 21, 2020. It does not include people who returned to the U.S. via State Department-chartered flights.
† Numbers closed out at 4 p.m. the day before reporting.

COVID-19: Cases among Persons Repatriated to the United States†

	Wuhan, China	Diamond Princess Cruise Ship†
Positive	3	36

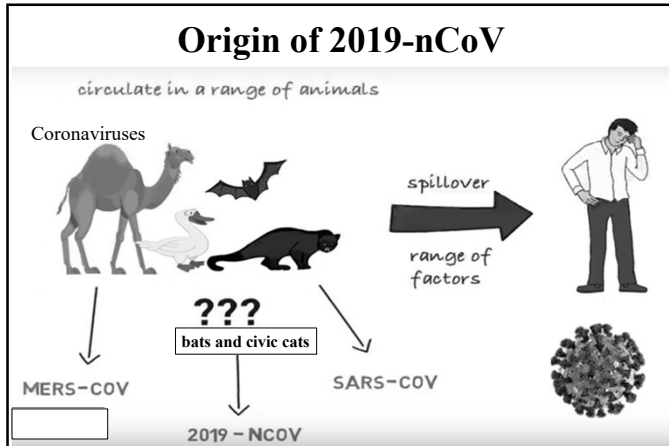
Global COVID-19 Situation (as of 2/24/2020)

- Global: 78,811 confirmed (1,017 new)
- China: 77,042 confirmed (650 new), 2,445 deaths (97 new)
- Outside China: 1,769 confirmed (367 new), 17 deaths (6 new), 28 countries

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SYMPTOMS

What is known so far

mild -----> severe

 fever
 cough
shortness of breath

Pneumonia Kidney failure Death

Mortality rate – 2-3%

DIAGNOSIS

PCR
(Polymerase Chain Reaction)
Genetic fingerprint

TREATMENT

no specific medication
supportive care
No vaccine

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How COVID-19 Spreads

Current information based largely on what is known about similar coronaviruses

- Person-to person
- Contact with virus-contaminated surfaces/objects touching item, then touching mouth, nose (possibly eyes ?)

1. Person most contagious when symptomatic
2. May also spread before symptoms appear (some case reports) not primary mode of transmission CDC (2/2020)

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Interim IC for Treating Pts. with or Suspected COVID-19 in HC Settings

- Minimize Chance for Exposures
- Adherence to Standard, Contact, and Airborne Precautions, Including the Use of Eye Protection
- Manage Visitor Access and Movement Within the Facility
- Implement Engineering Controls
- Monitor and Manage Ill and Exposed Healthcare Personnel
- Train and Educate Healthcare Personnel
- Implement Environmental Infection Control

“Routine cleaning and disinfection procedures (e.g., using cleaners and water to pre-clean surfaces prior to applying an EPA-registered, hospital-grade disinfectant to frequently touched surfaces or objects for appropriate contact times as indicated on the product’s label) are appropriate for 2019-nCoV in healthcare settings”
CDC. Interim Infection Prevention and Control Recommendations (2/12/2020)

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Critical Importance of Hand Hygiene

- 60-70% HAI related to improper hand washing & care
- MRSA, *C. difficile*, gram-negatives outbreaks pt-to-pt transmission from HCW hands
- Multiple hand washing guidelines since 1975
- New strategies & product types
- CDC 2002 guidelines – most recent & comprehensive
- CDC 2003 IC recommendations for dentistry
- Updated CDC dental IC guidelines (2016)
- Emerging HH issue ⇒ Increasing tolerance of *E. faecium* to handwash alcohol antiseptics

Boyce. Am JIC (2013); JAM. DE (2016); Pidot, et al. Science Trans Med. (2018)

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HAND HYGIENE

Multiple Acceptable Choices

- Non-antimicrobial soap
- Antimicrobial (antiseptic) soap
- Alcohol-based antiseptic

- Resident flora – normal microbial flora
- Transient flora – potential pathogens - acquired by direct contact - more easily removed

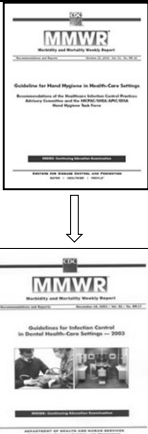
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III. Hand Hygiene

A. General Considerations

- Perform hand hygiene with either a non-microbial or antimicrobial soap and water when hands are visibly dirty or contaminated with blood or other potentially infectious material.
If hands are not visibly soiled, an alcohol-based hand rub can also be used. Follow the manufacturer's instructions.
- For oral surgical procedures, perform surgical hand antisepsis before donning sterile surgeon's gloves

MMWR 2003; 52(RR-17):1-66.



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Antimicrobial Spectrum / Characteristics of Hand Hygiene Antiseptic Agents

Group	Gram-positive bacteria	Gram-negative bacteria	Mycobacteria	Fungi	Viruses	Speed of action	Comments
Alcohols	+++	+++	+++	+++	+++	Fast	Optimum concentration 60%–95%; no persistent activity
Chlorhexidine (2% and 4% aqueous)	+++	++	+	+	+++	Intermediate	Persistent activity; rare allergic reactions
Iodine compounds	+++	+++	+++	++	+++	Intermediate	Causes skin burns; usually too irritating for hand hygiene
Iodophors	+++	+++	+	++	++	Intermediate	Less irritating than iodine; acceptance varies
Phenol derivatives	+++	+	+	+	+	Intermediate	Activity neutralized by nonionic surfactants
Triclosan	+++	++	+	—	+++	Intermediate	Acceptability on hands varies
Quaternary ammonium compounds	+	++	—	—	+	Slow	Used only in combination with alcohols; ecologic concerns

Note: +++ = excellent; ++ = good, but does not include the entire bacterial spectrum; + = fair; — = no activity or not sufficient.
*Hexachlorophene is not included because it is no longer an accepted ingredient of hand disinfectants.

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Alcohol-free, Waterless Hand Hygiene Antiseptics


Alcohol-based

- ✓ Evaporate quickly on skin
- ✓ Can dry skin c prolonged use
- ✓ Epidermal irritation over time?
- ✓ 60-85% ethanol or isopropanol

Non-alcohol-based

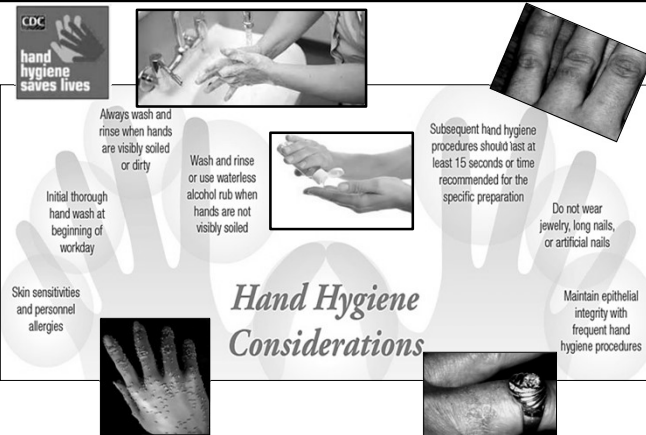
- ✓ Remain on skin longer
- ✓ Do not dry epithelium c repeated use
- ✓ Benzalkonium chloride
- ✓ Prolonged antibacterial activity**

**“improved persistent antibacterial activity compared to comparator ethanol-based formulation.”
Bondurant, et al. AJIC 47: 928-932 (2019)



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Hand Hygiene Considerations



Initial thorough hand wash at beginning of workday

Always wash and rinse when hands are visibly soiled or dirty

Wash and rinse or use waterless alcohol rub when hands are not visibly soiled

Subsequent hand hygiene procedures should last at least 15 seconds or time recommended for the specific preparation

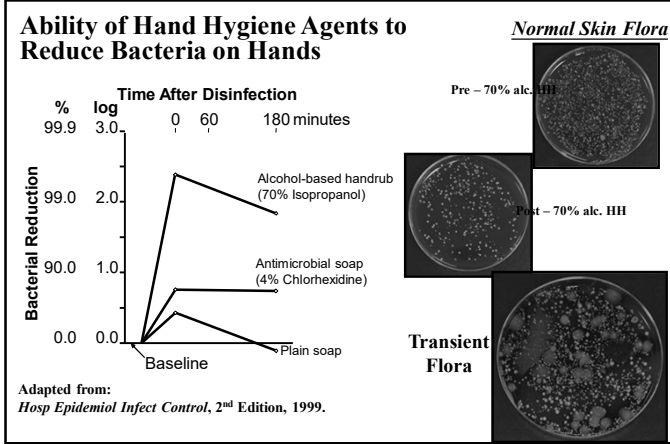
Do not wear jewelry, long nails, or artificial nails

Maintain epithelial integrity with frequent hand hygiene procedures

Skin sensitivities and personnel allergies

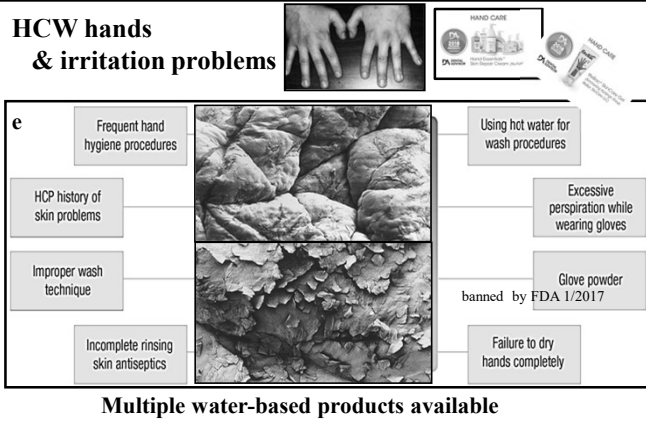
Hand hygiene saves lives

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HCW hands & irritation problems



Frequent hand hygiene procedures

Using hot water for wash procedures

Excessive perspiration while wearing gloves

Glove powder banned by FDA 1/2017

Failure to dry hands completely

Incomplete rinsing skin antiseptics

HCP history of skin problems

Improper wash technique

Multiple water-based products available


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Respiratory Hygiene/Cough Etiquette

- Combination of measures to limit droplet/respiratory spread
- Post CDC Respiratory Hygiene poster
- Often 1st point of pathogen encounter
- Strategies:
 - offer masks to coughing patients
 - encourage patients c symptoms to sit away from others if possible
 - this includes:
 1. patients/visitors with undiagnosed respiratory infections
 2. anyone with illness signs (i.e cough, congestion, runny nose)

Respiratory Hygiene

- Post CDC poster
- Provide tissues and disposal receptacles
- Provide resources for hand hygiene
- Offer masks to coughing patients
- Encourage patients with symptoms to sit away from others if possible



CDC

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Respiratory Hygiene/Cough Etiquette CDC (10/2016)

Elements To Be Assessed	Assessment	Notes/Areas For Improvement
A. Policies and procedures to contain respiratory secretions in people who have signs and symptoms of a respiratory infection, beginning at point of entry to the dental setting have been implemented. Measures include—	Yes <input type="checkbox"/> No <input type="checkbox"/>	
a. posting signs at entrances (with instructions to patients with symptoms of respiratory infection to cover their mouths/noses when coughing or sneezing, use and dispose of tissues, and perform hand hygiene after hands have been in contact with respiratory secretions)	Yes <input type="checkbox"/> No <input type="checkbox"/>	
b. providing tissues and no-touch receptacles for disposal of tissues	Yes <input type="checkbox"/> No <input type="checkbox"/>	
c. providing resources for patients to perform hand hygiene in or near waiting areas	Yes <input type="checkbox"/> No <input type="checkbox"/>	
d. offering face masks to coughing patients and other symptomatic persons when they enter the setting	Yes <input type="checkbox"/> No <input type="checkbox"/>	
e. providing space and encouraging persons with respiratory symptoms to sit as far away from others as possible—if possible, a separate waiting area is ideal	Yes <input type="checkbox"/> No <input type="checkbox"/>	
B. DHP receive training on the importance of containing respiratory secretions in people who have signs and symptoms of a respiratory infection	Yes <input type="checkbox"/> No <input type="checkbox"/>	

Key Recommendations for RESPIRATORY HYGIENE/COUGH ETIQUETTE in Dental Settings

- I. Implement measures to contain respiratory secretions in patients and accompanying individuals who have signs and symptoms of a respiratory infection, beginning at point of entry to the facility and continuing throughout the visit.
- II. Post signs at entrances with instructions to patients with symptoms of respiratory infection to—
 - a. Cover their mouths/noses when coughing or sneezing.
 - b. Use and dispose of tissues.
- III. Perform hand hygiene after hands have been in contact with respiratory secretions.
 - a. Provide tissues and no-touch receptacles for disposal of tissues.
 - b. Provide resources for performing hand hygiene in or near waiting areas.
- IV. Offer masks to coughing patients and other symptomatic persons when they enter the dental setting.
 - a. Provide space and encourage persons with symptoms of respiratory infection to sit as far away from others as possible. If available, facilities may wish to place these patients in a separate area while waiting for care.
- V. Educate DHP on the importance of infection prevention measures to contain respiratory secretions to prevent the spread of respiratory pathogens when examining and caring for patients with signs and symptoms of a respiratory infection.

CDC (2016)


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
Sharps Safety

- CDC: ~385,000 sharps injuries among hosp'l- based HCP (1,000 injuries/day)
- Most exposures in dentistry are preventable
- Dental practice should have policies & procedures in place that address sharps safety
 - take precautions while using sharps
 - take precautions during cleanup
 - take precautions during disposal
- Sharps accident prevention - primary IC goal

Sharps Safety

- Post CDC poster
- Provide tissues and disposal receptacles
- Provide resources for hand hygiene
- Offer masks to coughing patients
- Encourage patients with symptoms to sit away from others if possible






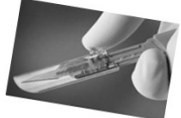
**Percutaneous injury
Mucous membrane exposure
Non-intact (broken) skin exposure
Bites**

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Needlestick Safety and Prevention Act (2000)

Federal OSHA standard requires:

- Use of engineering & work practice controls
- Recordkeeping on a Sharps Injury Log
- Written Exposure Control Plan
- Must reflect changes in technology use for prevention
- Document annual evaluation of safer sharps devices
- Employers required to solicit input from direct patient care personnel regarding identification & selection of engineering & work practice controls.


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Engineering Controls (EC)

- Device-based controls (i.e needle recappers, sharps containers, safety scalpels, sharps containers, scalpel blade removers, needless IV ports)
- EC should be primary method to reduce BBP exposure
- These controls remove or isolate the hazard

Engineering Controls (EC)

- Post CDC poster
- Provide tissues and disposal receptacles
- Provide resources for hand hygiene
- Offer masks to coughing patients
- Encourage patients with symptoms to sit away from others if possible





Work Practice Controls

- Behavior-based controls: modify task performance where necessary:
 - one handed scoop technique
 - do not bend or break needles
 - do not pass a syringe with an unsheathed needle
 - remove burs before disassembling handpiece
 - use insts in place of fingers for tissue retraction or palpation

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Sample Evaluation Forms

SAFETY NEEDLES/SYRINGE EVALUATION

Name: _____ Date: _____

Department: _____

Signature of the user: _____

Signature of the evaluator: _____

During the First Part of this Review...

Item	Compliant	Non-Compliant	Notes
1. The weight of the device was similar to the standard device being replaced.			
2. The device was easy to use.			
3. The device was easy to handle.			
4. The device was easy to dispose of.			
5. The device was easy to clean.			
6. The device was easy to store.			
7. The device was easy to transport.			
8. The device was easy to use in the field.			
9. The device was easy to use in the laboratory.			
10. The device was easy to use in the hospital.			
11. The device was easy to use in the clinic.			
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21. The device was easy to use in the police.			
22. The device was easy to use in the fire.			
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97. The device was easy to use in the home.			
98. The device was easy to use in the school.			
99. The device was easy to use in the community.			
100. The device was easy to use in the workplace.			

Did you use the device using the best? Yes No

If yes, describe: _____

Do you think this device will protect you from needles? Yes No

If no, why: _____

Based on your evaluation, which device would you prefer and (check one):

The new device is better

The old device is better

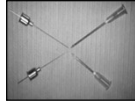
Neither device is better

Are there any additional design features or other performance considerations you would like to see in a safety modification that have not been mentioned? Any additional comments are best? _____

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Characteristics of Percutaneous Injuries Among DHCP

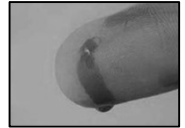
- Declining frequency
 - improved awareness & precautions
 - increased cassette use
- Most incidents: burs, other solid sharps, & **NOT** hollow-bore needles
- Most occur outside patient's mouth
- Small amounts of blood
- Needles – 25, 26, 27, 30 gauge vs. larger medical needles



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Does Practice Have A Post-Exposure Management Plan?

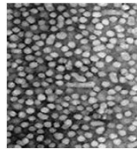
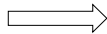
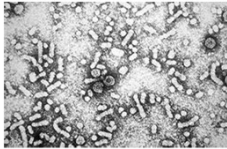
- Clear written policies and procedures
- Who will manage post-exposure process
 - Establish relationship in advance
 - Employee Health
 - Occupational Medicine
 - Emergency depts. / Urgent Care
- Education of dental health care personnel (DHCP)
- Rapid access to:
 - Clinical care (evaluation c/in 2 hrs)
 - Referral mechanisms to qualified HCP
 - Rapid HIV test
 - Post-exposure prophylaxis (PEP)
 - Testing of source patients/HCP
 - Payment of services
 - Wait times to be evaluated
 - Availability of HBIG, HBV vaccine, & HIV PEP
 - Confidentiality!!!



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Hepatitis B Vaccine History: 1982-2017

- Heptavax B (Merck) -- 1982
natural component vaccine from plasma of HBV carriers



- Recombivax HB (Merck) -- 1986/1987
in vitro recombinant DNA technology in yeast cultures
- Engerix B (SmithKline) -- 1986/1987
in vitro recombinant DNA technology in yeast cultures

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ORIGINAL HBV VACCINATION SCHEDULE

HBsAg + Alum Adjuvant $\xrightarrow{\text{IM injection; 1, 6 mos.}}$ Anti-HBs

Responses: after 1 dose: 30%-55%
after 2 doses: 75%
after 3 doses: $\geq 90\%$

Immunological Memory: >30 years; no current booster recommendation

Lower 3-dose seroprotection: advanced age, diabetes, renal disease, obesity, chronic illness, smoking, diabetes (31.3%-94.4%)
dialysis: (10%-83.5%)

Schillie, et al. Diab Care (2012); Sit, et al. World J Hepat (2015); CDC (2/2018)

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For People Who Do Not Respond to HBV Vaccination

Results of Additional Injections:

Injection	% Responding
4 th	25 %
5 th	40 %
6 th	50 %

IF recipient negative after 6 injections:

- ⇒ genetic hepatitis B vaccine non-responder.
- ⇒ active hepatitis B virus infection: prodromal or icteric disease phase
- ⇒ hepatitis B carrier (HBsAg +): vaccine ineffective

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HEPLISAV-B

- ▶ FDA licensed 11/9/2017
- ▶ Protection against all HBV subtypes in persons ≥ 18 yrs old
- ▶ Vaccine series: 2 doses, separated by 1 month
- ▶ Uses 018 adjuvant to stimulate directed response to HBsAg
- ▶ Clinical studies demonstrated high rates of seroprotection:
 - 90.0%-100.0% HEPLISAV-B recipients vs. 70.5%-90.2% recipients comparison group
 - Type 2 diabetes mellitus: 90.0% (HEPLISAV-B) vs. 65.1% (comparator)

Halperin, et al. Vaccine (2012); Janssen et al. Vaccine 2013; HEPLISAV-B package insert 11/2017

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Personal Protective Equipment

- ✓ A major component of Standard Precautions
- ✓ Protects skin & mucous membranes from exposure to infectious materials in spray or spatter
- ✓ Proven effectiveness against microbial pathogens
- ✓ Should be removed when leaving treatment areas
- ✓ Employers must:
 - provide PPE in appropriate sizes
 - clean, launder, dispose of PPE
 - repair/replace PPE as needed
 - ensure PPE isn't worn outside of clinical areas

OSHA PPE 1910.132

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Are Appropriate Gloves Available?

Considerations	Examples
Material	- latex, vinyl, nitrile, chloroprene
Skin sensitivity	- allergies to latex or nitrile - hand perspiration
Size	- proper size, lightweight & pliable - snug fit without hand constriction - appropriate finger length - fits palm without compression - ambidextrous vs. right- & left-fitted
Tactile sensation	- grip - glove thickness - slipperiness of material when wet
Function	- non-sterile gloves for most procedures - sterile gloves for surgical procedures - utility gloves reprocessing & clean-up - FDA bans powdered medial gloves beginning on 1/19/2017

Molinari & Nelson, TDA (2/2015)

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Are Hands Hurting When Wearing Gloves?

Hand & Wrist Risk Factors Associated with Dentistry

- ✓ Repetitive hand movements
- ✓ Awkward wrist positions
- ✓ Mechanical stresses to digital nerves (i.e. sustained grasping on instrument handles)
- ✓ Forceful treatment procedures in confined, small space
- ✓ Extended vibratory instrument use (i.e. handpieces, ultrasonic scalers)

39

Aerosols and Spatter: Rationale for Occupational Eye Protection

~2,000 workplace eye injuries/day (CDC)

40

Protective Eyewear




- OSHA adopted ANSI Z87.1 Std. as required std. for eye protection
- High impact resistance
- Side shields
- Sufficient size to cover and protect eyes
- Desirable: no fogging, scratch resistant, anti-static
- Face shields effective, but mask required
- Disposable eyewear available

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Do clinic personnel wear appropriate eye protection appropriately?

42

Representative Occupational Respiratory Infections








DISEASE	CAUSATIVE AGENT	TRANSMISSION
Tuberculosis	<i>Mycobacterium tuberculosis</i>	Droplet nuclei expelled by patient from coughing
Common cold	Rhinoviruses, Adenoviruses (most frequently)	Coughing and sneezing; contaminated environmental surfaces
Influenza	Influenza viruses	Spatier and aerosols associated with coughing; contaminated environmental surfaces
Severe Acute Respiratory Syndrome	SARS Coronavirus	Close person-to-person contact via aerosolized droplets and indirect contact from contaminated surfaces
Pertussis (whooping cough)	<i>Bordetella pertussis</i>	Coughing and sneezing
Legionnaires' Disease	<i>Legionella pneumophila</i>	Breathing in mist or vapor (small droplets of water in the air) containing the bacteria; not spread from person-to-person
Rubeola (measles)	Rubeola virus	Droplets from airborne secretions of infectious persons

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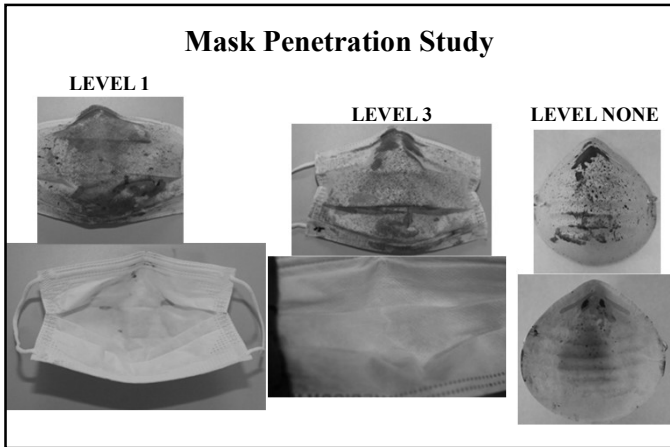
Masks: What to Wear & When

Molinari & Nelson. TDA (2014)

LEVEL:			
1	ASTM Low Barrier: For procedures where fluid, spatter, and/or aerosols are produced in low concentrations.	Procedures: - Patient Exams - Operatory Cleaning/Maintenance - Impressions - Lab Trimming, Finishing & Polishing - Orthodontics	
2	ASTM Moderate Barrier: For procedures where generation of fluid, spatter and/or aerosols is moderate.	Procedures: - Restorative/Composites - Endodontics - Prophylaxis - Scaling & Root Planning - Limited Oral Surgery	
3	ASTM High Barrier: For procedures where heavy to moderate levels of fluid, spatter and/or aerosols are produced.	Procedures: - Crown Preparation - Implant Placement - Use of Ultrasonic Scaler or Medicaments - Periodontal Surgery - Complex Oral Surgery	



<http://www.dentaladvisor.com/publications/translating-the-science/index.html>

44



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Are Masks Providing Adequate Respiratory Protection?

- ☞ Remember: masks become saturated from both sides
- ☞ "Wicking" of fluids through wet mask
- ☞ 20 min. routine use-life
- ☞ Face shield may lengthen use-life
- ☞ Secure mask to provide tight seal with face

46



N – 95 Respirators: NIOSH- approved particulate respirator (PRM)

- ☐ For: HCW working in close contact c pts with respiratory symptoms, influenza, or influenza-like illness
- ☐ Applications for current COVID-19 outbreak
- ☐ More efficient than masks used for routine pt treatment
- ☐ Work best when fitted properly - employers to ensure
- ☐ Difficulty breathing for some people > perceived discomfort
- ☐ More medical recs for N-95 in medicine when using lasers

47

AVAILABLE STERILIZATION METHODS

<ul style="list-style-type: none"> ☐ Steam under pressure (autoclaves) <ul style="list-style-type: none"> - Gravity Displacement (P-C OCM; Tuttenaur) - Steam Flush Pressure Pulse (M-11) - Fractionated Vacuum (Bravo; Statclave) - Steam Injection Pressure Pulse (Statin; M-3) ☐ Prolonged dry heat ☐ Plasma Sterilization ☐ Unsaturated chemical vapor 	<p>Heat – stable items</p> 
<ul style="list-style-type: none"> ☐ Ethylene oxide ☐ Chemical (cold) sterilization 	<p>Heat – labile items</p>  <p style="text-align: right;">JAM</p>

48

Is sterilization equipment properly monitored and records maintained?

☐ CDC recommends weekly biological monitoring

- In case of a positive spore test
 - ☐ Remove the sterilizer from service
 - ☐ Do not use the sterilizer until inspected and working properly

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Monitoring Indicators & Integrators

Class I (Process Indicators)
 Class II (Bowie-Dick Indicators)
 Class III (Temperature Specific Indicators)
 Class IV (Multi-Parameter Indicators)
 Class V (Type) (Integrating Indicators)

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Air Removal Test (pre-vacuum sterilizers) (Bowie – Dick Test)
 important test for sterilizer's air removal system

Daily Test Procedure – for every day sterilizer is used

1. Shortened cycle (no dry time) to heat up sterilizer
2. Place Bowie-Dick test pack in the sterilizer, flat on the lowest shelf over the drain w/o a load
3. Run 134°C/273°F for 3.5 min. cycle with little or no dry time
4. Remove test pack & check chemical indicator sheet
5. The sterilizer passes the air removal test if indicator sheet has a uniform color change (i.e. the center of the sheet is the same color as the edges)

unprocessed
 passed
 failed

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Monitoring Indicators & Integrators

Class I (Process Indicators)
 Class II (Bowie-Dick Indicators)
 Class III (Temperature Specific Indicators)
 Class IV (Multi-Parameter Indicators)
 Class V (Type) (Integrating Indicators)

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Are chemical indicators and BIs used & correctly interpreted ?

Yay!
 heat sterilization accomplished

Boo!
 failed cycle

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Error	Problem
Improper instrument cleaning and potentially compromise the sterilization process	Biological and other debris can shield adherent microbes and potentially compromise the sterilization process
Improper packaging	Examples: wrong type material for method; too many items in package; excessive amounts of wrap material
Overloaded sterilizer	Can prevent thorough contact of sterilizing agent with all items in unit
Inadequate Maintenance	Critical area; example issues include worn gaskets and seals
Improper sterilization equipment	Use of non-FDA approved equipment







Person in Charge !!

Sterilization Process Problems

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Single-Use Disposable Devices

- Introduced in 1960's –convenient & easy to use
- Designed for use on 1 patient & then discarded
- Not intended to be cleaned & sterilized for reuse on another patient
- Not heat tolerant & cannot be reliably cleaned
- More recyclables and biodegradables available
- Manufacturers required to document reprocessing reusable items – no reuse for single use devices!

Harte & Molinari; CDC (2003); RCDSO

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Instrument Reprocessing: Then and Now

Procedure	Representative 1980 Practice	Representative 2018 Practice
Manual instrument cleaning	Often primary method	Minimal
Chemical (i.e. cold) sterilization	Common glutaraldehyde use	Minimal or no use in practice
Ultrasonic cleaning	Used in conjunction with manual	Often primary method
Instrument washer	Not available	Increasing presence in practices
Biological monitoring for heat sterilization	Very few practices spore testing, infrequent intervals	Weekly spore testing required by regulatory agencies
Checks for cleaning processes prior to sterilization	Visual inspection of instruments	Visual inspection + artificial soil test strips for ultra-sonics and instrument washers

Molinari. Dent Today (2/2019)


Spaulding Classification (1970's)

Category	Definition	Examples in Dentistry	Comments
Critical	Penetrate soft tissue, contact bone, enter into or contact the bloodstream or other normally sterile tissue.	Surgical instruments, periodontal scalars, scalpels, surgical dental burs	Have the greatest risk of transmitting infection—clean and heat sterilize.
Semical	Contact mucous membranes or nonintact skin, but will not penetrate soft tissue, contact bone, or enter into or contact the bloodstream or other normally sterile tissue.	Dental mouth mirror, amalgam condenser, reusable dental impression trays, dental handpieces.	Have a lower risk of transmission—clean and heat sterilize. If a semical item is heat-sensitive, it should, at a minimum, be processed with high-level disinfection.
Noncritical	Contact with intact skin.	Radiograph head/cone, blood pressure cuff, facebow, pulse oximeter.	Pose the least risk of transmission of infection—clean and disinfect or use disposable barrier protection.

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Current Issues with Spaulding Classification

- Some semi-critical insts. may not be suitable for heat-sterilization or immersion in high-level disinfectants (HLD)
 - dispensing syringes
 - digital x-ray sensors
 - intraoral sections of dental technology devices
 - digital impression devices
- Special considerations – digital sensors
 - follow MIFU's for safely reprocessing
 - ideally, barrier protection should be used, followed by cleaning, heat sterilization, or HLD between pts.
 - if item cannot tolerate heat -- for minimum, use barriers then cleaning & disinfection c intermediate-level disinfectant between pts.




CDC (2003)


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Cleaning Instruments: Options


"Cleaning is the first step in every decontamination process" (CDC)



Mechanical (Hand Scrubbing)



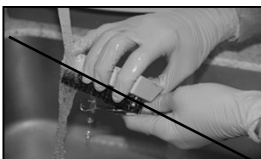


Ultrasonics




Inst Washer / Disinfectors

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If hand scrubbing is performed, is long handled brush utilized and utility gloves worn?




- ✓ Not as efficient as ultrasonic cleaners
- ✓ Dangerous – increased potential for sharps exposure when scrubbing instruments
- ✓ Wear utility gloves & other PPE
- ✓ Use of cassettes – manual cleaning not necessary



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Non- Medical Gloves

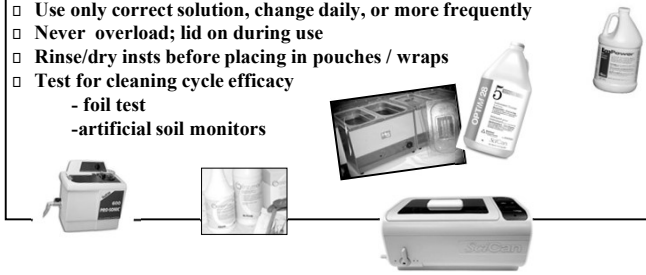
Indications	Comment
<ul style="list-style-type: none"> Housekeeping procedures Handling contaminated sharps or chemicals Not for use during pt. care 	<ul style="list-style-type: none"> Not FDA reg. medical device Commonly referred to as utility, industrial, or general purpose Latex gloves do not provide adequate chemical protection Sanitize after use

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Ultrasonic Cleaners

- Wear PPE – utility gloves, mask, glasses, clinical attire
- Sound waves cause bubbles to implode, loosening debris
- Dual enzymatic & detergent solns
- Remove of gross debris before ultrasonics
- Use only correct solution, change daily, or more frequently
- Never overload; lid on during use
- Rinse/dry insts before placing in pouches / wraps
- Test for cleaning cycle efficacy
 - foil test
 - artificial soil monitors

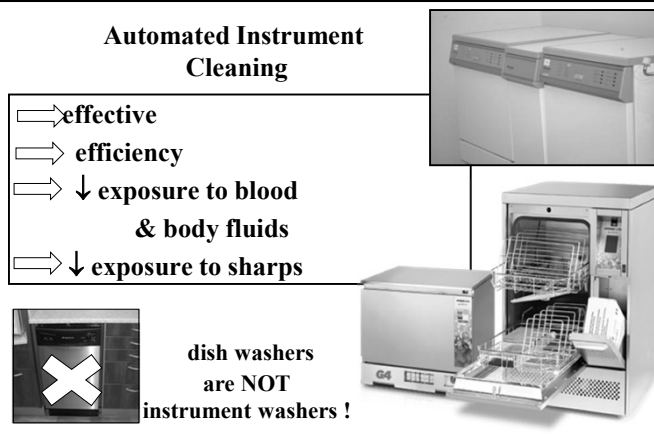


61

Automated Instrument Cleaning

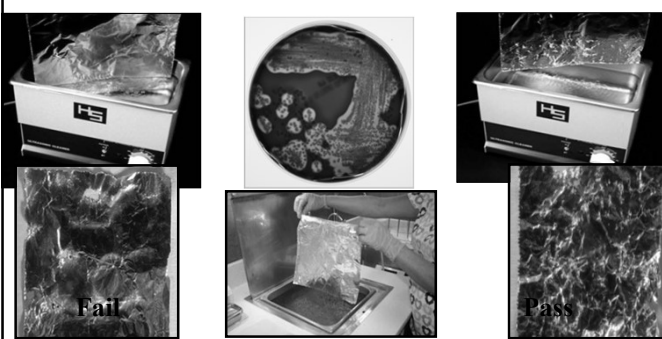
- ⇒ effective
- ⇒ efficiency
- ⇒ ↓ exposure to blood & body fluids
- ⇒ ↓ exposure to sharps

dish washers are NOT instrument washers !



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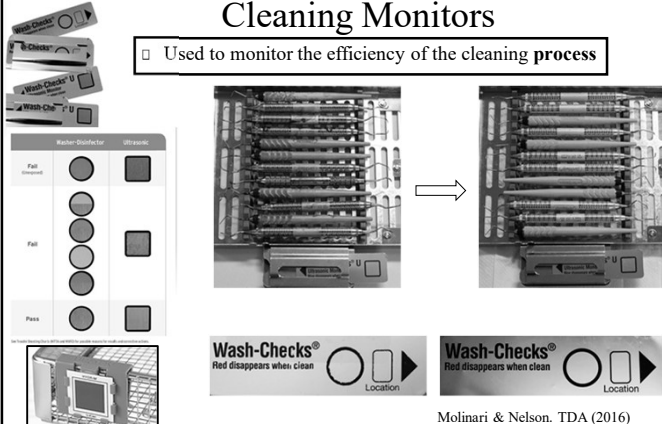
When ultrasonic is utilized, is periodic testing performed?



63

Cleaning Monitors

- Used to monitor the efficiency of the cleaning process



Molinari & Nelson. TDA (2016)

64

Sterilized Wrapped Instruments

Keeping Instruments Wrapped Until Patient Treatment

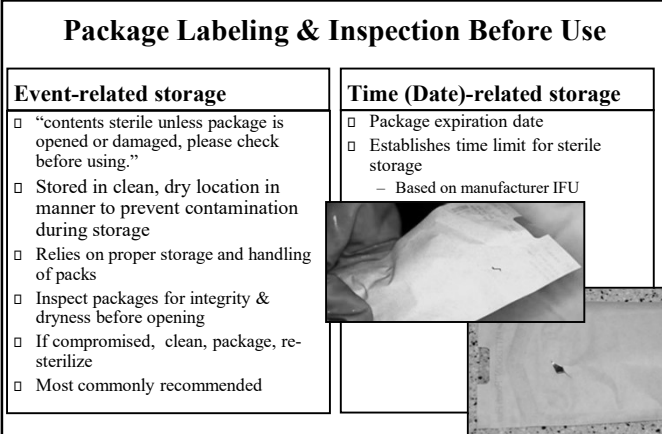
The Pay – off : Patients Note Sterile Packages (Perception & Reality)



65

Package Labeling & Inspection Before Use

Event-related storage	Time (Date)-related storage
<ul style="list-style-type: none"> □ “contents sterile unless package is opened or damaged, please check before using.” □ Stored in clean, dry location in manner to prevent contamination during storage □ Relies on proper storage and handling of packs □ Inspect packages for integrity & dryness before opening □ If compromised, clean, package, re-sterilize □ Most commonly recommended 	<ul style="list-style-type: none"> □ Package expiration date □ Establishes time limit for sterile storage <ul style="list-style-type: none"> - Based on manufacturer IFU



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CDC IC Recommendations for Handpieces

- Semi-critical devices; internal components can become contaminated with patient materials during use.
- Follow manufacturers' IFUs for reprocessing!
- "Dental handpieces and associated attachments, including low-speed motors and reusable prophylaxis angles, should always be heat sterilized between patients and not high-level or surface disinfected." (CDC, 2016)



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Are Clinical Contact Surfaces Covered or Cleaned & Disinfected Between Patients?

- Cleaning
- Sanitization
- **Disinfection**
- Sterilization



68

Microbial Persistence on Dry Inanimate Surfaces

Microorganism	Duration of Persistence
□ <i>Staphylococcus aureus</i> , incl. MRSA	7 days – 7 months
□ <i>Mycobacterium tuberculosis</i>	2 days – 4 months
□ <i>Bordetella pertussis</i>	3 – 5 days
□ <i>Enterococcus sp.</i> (incl. VRE)	5 days – 4 months
□ <i>Clostridium difficile</i> spores	up to 2 yrs.
□ <i>Escherichia coli</i>	1.5 hrs. – 16 months
□ <i>Candida auris</i>	> 1 month
□ Influenza viruses	1 – 2 days
□ Rhinoviruses	2 hrs – 7 days
□ Herpes simplex viruses (HSV)	4 hrs. – 8 wks.
□ Hepatitis B Virus (HBV)	> 1 wk. (in blood)
□ Hepatitis C Virus (HCV)	16 hrs. – 6 wks. (in blood)
□ Hepatitis A Virus (HAV)	2 hrs. – 2 months
□ Human Immunodeficiency Virus (HIV)	few min. – 7 days**

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Categories of Patient Items

- Critical
- Semi-Critical
- Noncritical



Categories of Environmental Surfaces

- Clinic Contact Surfaces: (light handles, switches, tray)
may be touched frequently with gloved hand during pt care, or may become contaminated with blood / OPIM
- Housekeeping Surfaces: (floors, walls, sinks)
do not come into contact with devices used in dental procedures; cleaned on regular basis

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Surface Covers:

- a. Use appropriate disposable cover materials
- b. Change between patients

Advantages

1. Prevents contamination
2. Protects difficult-to-clean surfaces
3. Less time-consuming
4. Reduces chemical use
5. More eco-friendly choices

Disadvantages

1. Need varied sizes / types
2. Non- biodegradable plastics
3. Esthetically undesirable?
4. Additional costs over chemical sprays ?



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Properties of an IDEAL Surface Disinfectant

- broad antimicrobial spectrum
- rapid, lethal action on all vegetative forms
- not affected by physical factors (i.e. active in presence of organic matter)
- non-toxic; non-allergenic; easy to use
- surface compatibility: should not compromise integrity of equipment & metallic surfaces
- residual effect on treated surfaces (reactivation of agent when moistened)
- odorless
- eco-friendly (does not add "damaging" chemicals to environment)

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73

Does the dental unit water meet EPA regulatory standards for drinking water?






Use water that meets regulatory standards for drinking water (< 500 CFU/ml of heterotrophic water bacteria) for routine dental treatment output water. CDC (2003)

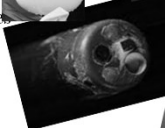


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Health Facility Reservoirs as Potential Sources of Waterborne Infections

- Potable & hospital water systems
- Showers
- Sinks
- Faucet aerators
- Nebulizers
- Ice and ice machines
- Eyewash stations
- Dialysis water
- Hydrotherapy tubs
- Endoscopes


hospitals outbreaks predominantly linked to water sources


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Eyewash Stations

Health Effects from Contaminated Water in Eyewash Stations
 Eyewash stations used in workplaces must be maintained to prevent injury and illness to workers. This InfoSheet provides updated information on eyewash station hazards.



- Improper maintenance contain MO's
- Activated weekly (15 mins)
- Reduce microbial contamination
- Follow manufacturer's IFUs




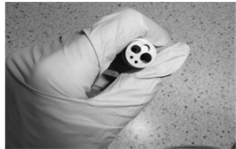
76

Key HC Waterborne Notes

- Many HC-associated infections linked to contaminated potable/tap water & hospital water systems
- Major risks: immunocompromised & severely ill patients
- Common pathogens: gram-negative bacilli (eg, *Pseudomonas*, *Stenotrophomonas*, *Legionella*) & NTM
- **All** water, except for sterile water & filtered water, is contaminated c microbes (eg, potable water, tap water, showers, and ice).
- **What is "safe" microbial level in HC water supplies/systems?**

77

Does the dental unit water meet EPA regulatory standards for drinking water?

- Use water that meets regulatory standards for drinking water (< 500 CFU/ml of heterotrophic water bacteria) for routine dental treatment output water. CDC (2003)
- Most untreated dental unit water samples:
 1,000 to 10,000 CFU
 (some DUWL >1,000,000 CFU documented)

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Significance of Waterborne Microorganisms

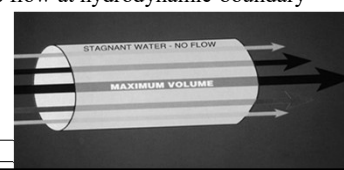
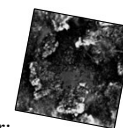
Widespread in nature → lakes, streams
 Water distribution systems → cooling units
 Industry & health care → piping, tubing
 Water supplies → potable, municipal, distilled
 Health care → catheters, scopes, IUD
 Human infections → endocarditis, respiratory, periodontitis

Environmental Disease Outbreaks
Legionella, *Pseudomonas*, *Cryptosporidium*, Nontuberculous
 Mycobacteria (NTM)

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Rapid Growth of Microbes in DUWL Biofilm caused by:

- Small diameters of waterlines
- System design: dead legs; control blocks
- Tubing materials conducive to biofilm growth
- Surface-to-volume ratio: smaller cylinder diameter; larger the surface area available for colonization by same volume of water
- Slow water flow --very little flow at hydrodynamic boundary
- Low volume of water used
- Water warms to room temp.
- Low usage



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DUWL Biofilm Formation

Attachment → Colonization → Growth

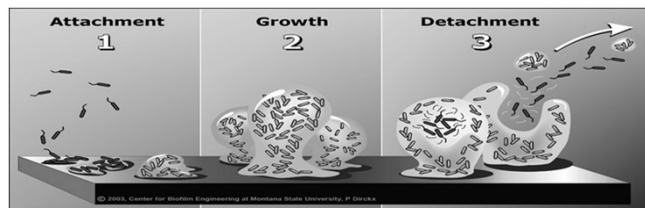
Planktonic cells → Sessile cells

BULK FLUID → SURFACE

81

Biofilm Characteristics

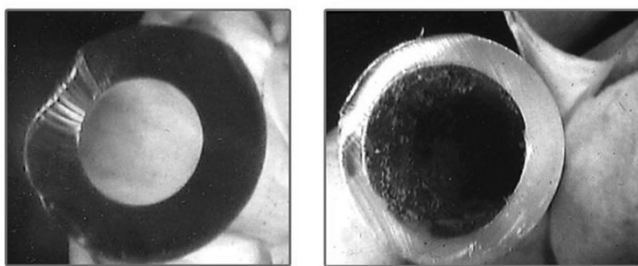
- ☛ Highly complex microbial structural entity
- ☛ Organisms provide nutrients to each other
- ☛ Exists in all environments, including water and solids
- ☛ Microorganisms grow very well in stagnant water
- ☛ Flushing does not reliably improve dental water quality



Source: Molinari J, Harte J, *Practical Infection Control In Dentistry* (2010)

82

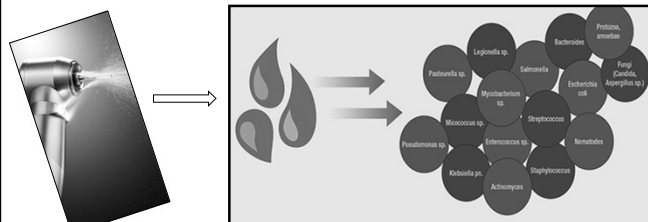
How Fast Can Biofilms Grow?



photos permission of Hu-Friedy & J. Chandler (2018)

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Representative Isolated DUWL Microbes



- ☛ waterborne infections & disease in hospital/public health settings
- ☛ many involve medical devices (nebulizers, endoscopes)
- ☛ most DUWL MO's from public water supply; not high risk for healthy persons
- ☛ however, increasing # of immune compromised dental pts "opportunistic pathogens" from waterborne MO's

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Recent DUWL Developments

~~No current definable public health problem~~

Waterborne infection is a major public health concern and unacceptable to use highly colonized water for any kind of dental treatment

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Recent Public & Healthcare Waterborne Outbreaks

Year	Infection Etiology	Contaminated Water Source	Outcome/Impact
2010	<i>Legionella pneumophila</i>	Hospital decorative water fountain	Legionnaires' disease
2011	<i>Klebsiella oxytoca</i>	Hospital handwashing sink	Pneumonia; abdominal abscess
2011	<i>Legionella pneumophila</i> ¹	Handpiece waterlines in a dental practice	Legionnaires' disease
2012	<i>Pseudomonas fluorescens</i>	Drinking water in bone marrow transplant unit	Febrile nosocomial infection with neutropenia
2014	<i>Legionella pneumophila</i>	City water system	Legionnaires' disease
2014	<i>Mycobacterium chimera</i>	Surgical heater-cooler units in surgical operating rooms	Endocarditis; blood stream infection
2015	<i>Legionella pneumophila</i>	Cooling towers on commercial building	Legionnaires' disease
2015	<i>Mycobacterium abscessus</i> ²	Tap water used to perform pulpotomies	Odontogenic infection
2016	<i>Mycobacterium abscessus</i> ³	Tap water used to perform pulpotomies	Odontogenic infection
2017	<i>Pseudomonas aeruginosa</i>	Electronic tap water faucets in neonatal units	Bacteremia
2017	<i>Legionella pneumophila</i> ⁴	Dental waterlines	Legionnaires' disease
2018	<i>Legionella pneumophila</i>	Hotel hot tub and other non-maintained water sources	Legionnaires' disease

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Pseudomonas Case Report in Dentistry

Ps. aeruginosa wound infections

- Gingival infections in 2 immune compromised pts after restorative treatment
- *Ps. aeruginosa* in DUWL matched to bacteria cultured from pt wounds
- Pts treated for infection w/o any sequelae
- Also found – carriage of *Ps. aeruginosa* detected in 78 other asymptomatic pts

Martin. Brit Dent J (1987)

87

DUWL Infection Control

- Progress in developing reliable methods to control biofilm formation
- FDA-cleared & FDA-registered products available
- When used **properly** can provide high-quality water for patient care
- Choices include:
 - EPA-registered chemical germicides or antimicrobial surface tx's
 - independent water reservoirs (isolate units from municipal water)
 - automated germicide metering devices with microfiltration technology (can be used with independent reservoirs or municipal water connections)
 - sterile water delivery systems
- System in place for periodic monitoring of bacterial levels

Mills, et al. OSAP (2017)

88

Independent Reservoirs

- Most economical option
- Must follow MIFUs for acceptable agents & treatment frequency
- Must use water of acceptable quality
- Disinfect reservoirs and use aseptic technique when handling
- Useless without appropriate chemical treatment



Photos Courtesy of Shannon Mills, DDS and Crosstex, Inc



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Treating Dental Unit Waterlines

Complete DUWL systems include use of antimicrobial cleaner + maintenance product

CLEANING with registered antimicrobial KEY to removing microbial deposits; also termed “shock” chemical
- does not come into contact with mucosal tissues

MAINTENANCE product prevents waterborne organisms from attaching, colonizing, proliferating in tubing
- can come in contact with mucosal tissues



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DUWL Filtration Devices

- Reverse Osmosis (RO or hyperfiltration)
- Deionization
- Distillation
- Some devices also filter and condition water to improve efficacy

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Issues Related to Tap Water & Plumbing

- Tap water often exceeds 500 cfu/mL
- Outbreaks can be due to tap water quality (Flint, MI !!)
 - aquatic biofilms may include opportunistic pathogens
 - plumbing dead legs and faucet aerators provide reservoirs for biofilm growth

Mills. OSAP Boot Camp (1/2020)

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IC for Dental Unit Waterlines (DUWL)

- Follow manufacturer’s IFUs for daily/weekly maintenance
- Do not use waterline heaters
- When recommended, shock waterlines c strong chemical
- Remove handpieces, A/W tips, ultrasonic scalers before flushing
- Flushing at beginning/end of day for at least 2-3 minutes
- Handpieces flushed 20-30 seconds after patient care
- Sterile water/saline when irrigating open surgical sites and when cutting bone during surgical procedures
- Test waterlines consistently to confirm maintenance protocol effectiveness and determine proper shock frequency

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CA Dental Legislation AB1277

- ☛ Filed in October, 2017--- implemented by 12/31/2018
- ☛ Requires **Dental Board of California (DBC)** to revise minimum standards for infection control “*to require water or other methods used for irrigation to be sterile or contain recognized disinfecting or antibacterial properties when performing dental procedures that expose dental pulp*”
- ☛ California (1st state) now requires DUWL testing
- ☛ Others developing similar rules (i.e. Washington)

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Clinical Monitoring of DUWL

- OSAP 2018: recommends periodic monitoring & inspection at least monthly following installation of treatment devices, or initiation of new protocols
- When monitoring shows acceptable counts for 2 consecutive monthly cycles, frequency of testing may be reduced, but not less than every 3 months
- When a dental unit exceeds the action limit, treat according to manufacturer IFU, and re-tested immediately after tx
- Periodic, consistent monitoring key to improving water quality

Dental Unit Water Quality: Organization for Safety, Asepsis and Prevention (OSAP) White Paper and Recommendations–2018); Mills. OSAP Boot Camp (1/20/2020)

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Monitoring Options

- Recommended by ADA to monitor effectiveness of tx's
- Water testing laboratory (multiple commercial choices)
- In-office testing with self-contained kits
- Follow recommendations provided by manufacturer of DUWL treatment product for monitoring water quality (i.e. IFU)



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Thank You

QUESTIONS ??

QUESTIONS ??

QUESTIONS ??

QUESTIONS ??

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